DOCUMENT RESUME

ED 193 587 CG 014 748

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TITLE Using Public Data to Evaluate Mobility-Based Occupational Classifications for Placement of Job Applicants.
INSTITUTION Johns Hopkins Univ., Baltimore, Md. Center for Social Organization of Schools.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Jul 80
GRANT NIE-G-78-0210; NIE-G-80-0113
NOTE 77p.; Paper presented at the Annual Convention of the American Psychological Association (88th, Montreal, Quebec, Canada, September 1-5, 1980). Best copy available. Tables are of marginal reproducibility.

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Adults; *Classification; Data Analysis; Employees; *Individual Characteristics; Job Analysis; *Job Placement; *Labor Market; National Surveys; *Occupational Clusters; *Occupational Mobility; Occupations

ABSTRACT

The experimental development of occupational classifications based on regularities of movement of workers among jobs has been used recently to place job seekers in available jobs. The social and psychological meaning of a classification, developed by Dauffenbach, was explored by describing the classification's categories in terms of the demographic characteristics of category incumbents (based on data from the 1970 census) and job content (based on the Dictionary of Occupational Titles and Position Analysis Questionnaire data). Results imply that mobility-based classifications: (1) provide powerful descriptions of the structure of labor markets; (2) are related to job content; and (3) are also related to sex and race, well beyond the extent to which this association is shared with job characteristics. Findings suggest that basing a classification for personnel placement on occupational mobility patterns may incorporate undesirable aspects of existing labor market practices, and that more direct efforts aimed at systematizing knowledge about the transferability of skills may be more productive than relying on mobility-based classifications, despite the heuristic value of the mobility approach. (Author)

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Using Public Data to Evaluate Mobility-Based Occupational Classifications for Placement of Job Applicants

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July 1980

CG 014748

This research was supported in part by Grants NIE-G-78-0210 and NIE-G-80-0113 from the National Institute of Education, Department of Health, Education, and Welfare. This report draws on discussions with and memoranda by John A. Hartigan, Ernest J. McCormick, Ann R. Miller, and Charles F. Turner. We are grateful to Linda S. Gottfredson and Patricia Roos for helping us locate and use Census and Department of Labor data, and to Robert Mecham for making Position Analysis Questionnaire Data available. No agency, institute, or committee endorses the opinions expressed--they are solely the authors'.

Paper prepared for the Annual Meeting of the American Psychological Association, Montreal, 1 September 1980.

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Developing schemes for assessing the suitability of individual workers for a variety of jobs has been a continuing goal of industrial and counseling psychologists and psychometricians (Coombs & Satter, 1949; Pearlman, 1980; Super, 1979; Holland, 1973; Guion, 1976; McCormick, 1976). The pursuit of this goal has spawned rating scales, interest inventories, structured job analysis inventories, occupational classifications, taxonomies of human performance, aptitude batteries, task analysis methods, and theories of vocational choice and adjustment.

A National Academy of Sciences Committee (Miller, Treiman, Cain, & Roos, 1980) has recently suggested an alternative to these traditional psychological approaches to matching workers with jobs. Specifically, the Committee suggested exploring the development of classifications based on regularities in the movements of workers among jobs. If workers who have done job X in the past, are found to be hired or employed in job Y with considerable frequency, then presumably the two jobs have something in common which makes such transitions especially likely to occur. One possibility is that they require similar worker skills or are suitable for persons with similar preferences. Other possibilities exist.

The present report explores one classification developed using regularities in the movements of workers among occupations. It focuses on what occupations within the categories of that classification have in common and how the categories differ. Specifically, it examines the extent to which job analysis data suggest similarities within categories

and differences among them; and it examines the extent to which the regularity in inter-occupational mobility summarized by the classification is also related to education, age, sex, and race. To provide some perspective on the mobility approach to occupational classification, the concept of worker-job match, the purposes of classification, and some psychological approaches to worker-job matching are first briefly reviewed.

The Concept of Worker-Job Match

Jobs differ in the demands they make of workers. For example some require a higher degree of visual or auditory acuity, agility, or skill in interpersonal relations than others. Workers also differ in personal characteristics such as sensory acuity, dexterity, or interpersonal skills. The attempt to promote individual welfare or meet the needs of employers by seeking a match between workers and jobs has a long history (DuBois, 1964; Parsons, 1909; Patterson, Gerken, and Hahns 1953; Patterson and Darley, 1936). The basic idea is that individuals with specific characteristics are best suited for specific kinds of jobs. If a person's characteristics correspond to the demands of the work, it is assumed that the person will be more likely to seek, be hired for, persist in, perform well in, or like that line of work. Today there exists persuasive evidence that the degree of person-job match does result in these outcomes to a certain extent (see, for example, Lofquist and Dawis, 1969; Crites, 1969; Campbell, 1971; Dunnette, 1976; Dunnette & Borman, 1979; Ghiselli, 1973; Owens, 1976). At the same time it is also true that a given individual is suited for many different jobs or

occupations. This is so because the range of abilities, interests, or other personal characteristics of workers in a particular occupation is usually wide (Stewart, 1947; Crites, 1969); because the correlations observed between measures of personal characteristics and any particular outcome are typically modest, usually ranging from .1 to .6 (Dunnette, 1976; Ghiselli, 1973); and because many occupations are similar in terms of the demands they make on workers or the rewards they provide (Occupational and Career Analysis and Development Branch, 1977).

One purpose of occupational classifications is to provide an organization of occupations into groups which are similar in the sense that they tend to make similar demands on workers or in which workers with more or less distinctive patterns of characteristics are likely to find satisfactory employment. This is a major purpose of occupational classifications intended for counseling and placement.

Purposes of Occupational Classification

Sokal (1974) describes several general purposes of classifications: (a) The arrangement of objects (occupations) into groups or taxa which may be named and related to each other facilitates manipulation and retrieval of information. (b) Classifications aim to achieve economy of memory and aid communication my making it possible to summarize and attach labels to information. (c) Classifications serve to describe the relations of objects (occupations) to each other in such a way that general statements can be made about classes of objects. (d) Classifications generate hypotheses by raising questions about how the order made perceptible by the classifications has come about. A classification

based on occupational mobility may be useful in many of these ways, but still be of limited use in counseling or placement.

Occupational classifications have been sought for purposes other than that of matching workers with jobs. The Census Bureau's classification, stemming from Edwards' early work (1911, 1933) was a more or less ad hoc classification which has been used, with some changes, over the years to organize information about the socioeconomic composition of the population. The Standard Occupational Classification (Office of Management and Budget, 1977) is a similar classification intended to provide a standard method for organizing occupational data generated by Federal agencies.[1]

Researchers outside of psychology have been concerned with the empirically based development of occupational classifications for other purposes. Sociologists (Duncan, 1961; Siegal, 1971; Treiman, 1977) have sought classifications that rank order occupations in terms of prestige or socioeconomic status to facilitate the study of who gets ahead. And economists (Cain, Hansen, & Weisbrod, 1967; Dauffenbach, 1973; Kelley, Chirikos, & Finn,1975; and Scoville, 1965) have sought classifications useful for workforce forecasting. In such a classification, "Each class of jobs should be such that the elasticity of substitution among jobs in that class (or rather, among various workers who can perform those jobs) will on average be higher than the elasticity of substitution between jobs in different classes" (Cain et al., 1967). In other words, they seek a classification of occupations such that within a category, occupations can easily exchange incumbents.[2] Dauffenbach (1973) and Hartigan and Turner (1980) have directly attacked

the problem of developing a classification aimed at the substitution of workers by developing classifications using patterns in the transfer of workers among jobs as the basis of clustering.

Psychological Approaches

Psychologists have pursued job analysis and classification for a variety of purposes. These include personnel placement, selection, compensation, counseling or guidance, and the development of training or promotion schemes. Pearlman (1980) has provided a recent review of much of the psychological work in this area. A number of different lines of inquiry have been pursued in analyzing jobs and developing classifications.

One of these is exemplified by the work of McCormick, Jeanneret, and Mecham (1972) who have devised a way of assessing jobs along dimensions, developed through factor analysis, of "worker-oriented job elements." This line of research focuses on the human behavior performed in getting work done. McCormick and his colleagues have developed a questionnaire to assess jobs in terms of several dimensions of worker behavior that characterize differences among jobs. This structured job analysis technique has potential for developing classifications useful in matching workers with jobs--as well as for other purposes, such as suggesting selection devices or contributing to the development of a pay policy. The use of structured job analysis techniques of this kind to develop classifications is well illustrated in the literature (Taylor, 1978; Taylor & Colbert, 1979; Pass & Cunningham, 1976; Shaw, DeNisi, & McCormick, 1977; Mecham, McCormick, & Jeanneret, 1977b).

A second approach to analysis and classification involves the description of jobs in terms of the activities or tasks performed. The distinction

between this approach and the former is that this approach emphasizes what is done rather than what the worker does. This approach is Illustrated by the Air Force work on task analysis (discussed by McCormick, 1979) and some aspects of the U. S. Department of Labor's (1972) methods of job analysis. Task inventories are questionnaires containing a list of tasks, and are usually used for analyzing jobs within a fairly narrow range of differences because they usually involve specific or specialized tasks (see U.S. Department of Labor, 1973a,b; Christal, 1974). Nevertheless, an illustration that classification is possible using this task-focused approach is provided by the job descriptions for some military occupations reported by Morsh (1966) and by classifications of managers developed by Torrow and Pinto (1976).

A third approach to job analysis and classification focuses on the characteristics of workers which are related to job performance. Fleishman (1975) summarizes work on the development of a taxonomy taking this approach.

Other, less direct approaches to occupational classification have been pursued by counseling psychologists (Holland, 1973; Holland, Viernstein, Juo, Karweit, & Blum, 1972; Lofquist & Dawis, 1969; Dawis, Lofquist, Henly, & Rounds, 1979). One distinctive feature of this work is that it has attempted to create explicit structures for comparing the characteristics of workers and of occupations. This is important because knowledge of the structure of occupational characteristics and of the structure of worker characteristics is useful in matching workers with jobs only when the relation between job and worker characteristics is spelled out. Although the three psychological approaches to understanding worker job match mentioned earlier may be better suited to explicating the dimensions of occupational

and worker characteristics than these indirect or global counseling approaches, they have yet to provide really comprehensive structures for integrating worker and job characteristics.

The emergence of occupational or worker classifications from each of these lines of inquiry testifies to their heuristic and practical value in organizing knowledge (cf. Pearlman, 1980). The suggestion (Miller et al., 1980) that classifications which bypass the direct examination of worker and job characteristics and instead focus directly on the substitutability of workers might be developed and used in placement warrants scrutiny. In the remainder of this report, one such classification is examined with regard to its potential as a prototype for a classification useful for the counseling or placement of workers.

Method

Several alternative classifications developed by clustering occupations on the basis of patterns of movement of workers among them are available. Dauffenbach (1973) provides eight of these, and Hartigan and Turner (1980) provide one. All of these classifications are based on 1970 census data (U.S. Bureau of the Census, 1970, 1972) in which each respondent's 1970 occupation was classified into the 3-digit census classification for occupations (U.S. Bureau of the Census, 1971), as was a retrospective report of the person's occupation five years earlier.[4] The 1970 occupational codes are based on more extensive questioning than are the 1965 reports, which also probably incorporate some recall error and underreporting (U.S. Bureau of the Census, Economic Statistics Branch, 1970).

Subjective judgment was involved in selecting the particular set

of cluster results to examine here--we did not wish to explore them all. One of Dauffenbach's clusterings was chosen on the grounds that it was intuitively appealing. Similarly, the choice of a point to stop clustering is essentially arbitrary, and we examined several alternatives and chose one that seemed sensible and gave us a reasonable number of clusters with 10 or more occupations per cluster. Naturally, the details of our results will be influenced by our judgments in these matters.[5]

The occupational content of the mobility-based clusters examined is presented in Appendix Table A-1. The first column shows the arbitrary cluster number assigned to the cluster. The second column shows the three-digit census occupational code (leading zeros dropped), and the verbal description is presented as an aid to interpretation. These clusters have intuitive appeal. That dentists and physicians do not cluster with other groups is understandable given the pervasive credential barriers involved and the heavy investment in specific training regimens required for entry. And cluster 5, health technicians, seems to be a reasonable cluster. Other clusters usually accord with common sense or rational groupings, although there are some exceptions. (Dauffenbach, 1973, notes that they appear to accord with Scoville's, 1969, "job family" classification.) One way of regarding this classification is as a characterization of the structure of occupational mobility in the U.S. economy for the 1965-1970 period. It is a portrait that summarizes regularities in occupational transitions in a relatively "theory free" way.

Data used to describe the clusters come from several sources:

1. Job analysis data developed in the process of producing the fourth edition of the Dictionary of Occupational Titles (DOT).

The National Research Council Committee on Occupational Classification and Analysis (Miller et al., 1980) has provided scores for 1970 census 3-digit occupations on four dimensions that appear to underly the ratings of occupations in the DOT. The 46 worker traits and worker functions rated in the DOT were factor analyzed at the census occupation level, resulting in four factors. Standardized ratings that defined these factors were summed with appropriate sign and with unit weight.[6] This resulted in four scales defined as follows:

(a) Substantive complexity is a scale based on the following fourth edition DOT ratings: data (worker function), GED (general educational development), SVP (specific vocational preparation), intelligence (aptitude rating), verbal (aptitude rating), numerical (aptitude rating), abstract (interest rating), and repetitive or continuous process (temperament rating--scored negatively).

(b) Motor skills is formed by summing the following ratings: things (worker function), motor coordination (aptitude), finger dexterity (aptitude), manual dexterity (aptitude), color discrimination (aptitude), and seeing (physical demand).

(c) Physical demands is formed by summing the following ratings: eye-hand coordination (aptitude), climbing (physical demand), stooping (physical demand), location (working condition), and hazards (working condition).

(d) Undesirable working conditions is formed by summing the following ratings: cold (working condition), heat (working condition), wet (working condition).

These DOT-based data are used as a source of information because the DOT is the single most comprehensive source of information about the content of occupations in existence. Composite scales derived from the DOT ratings seemed appropriate because research (Miller et al., 1980; Broom, Jones, & McDonnel, 1977) implies that there is substantial redundancy in the ratings made by the Employment Service.[7]

2. Structured job analysis data using the Position Analysis Questionnaire (Mecham, McCormick, & Jeanneret, 1977a). In contrast to the DOT information, which resembles task analysis in some ways and which also attempts to infer the characteristics of workers related to performance, the PAQ is the major worker-oriented job analysis instrument in use today. The PAQ archives contained data for 1781 distinct 9-digit DOT occupations. The number of protocols for each of these ranged from 1 to 877. Using the Classified Index (U.S. Bureau of the Census, 1970), each of these 9-digit DOT codes was recoded to a 3-digit census code, and PAQ dimension scores were aggregated to the detailed census occupation level.[8] This resulted in useable scores for 304 of the 440 census occupations. The PAQ generates several types of dimension scores, based on various parts of the questionnaire. The thirteen overall dimension scores were used in the present research because these appear to provide the most comprehensive single set of job descriptors.

The following list describes the job component scores used by giving a title, marker items, and illustrative high- and low-scoring occupations identified by occupational title and fourth edition DOT code:[9]

(a) Having decision, communicating, and general responsibilities; advising, negotiating, nonroutine information exchange; presi-

dent of industrial organization (189.118-022), hospital cleaner (323.687-010).

(b) Operating machines or equipment; setting up/adjusting, assembling, variable setting controls; engineering development technician (003.161-014), food products sales representative (260.357-014).

(c) Performing clerical or related activities; transcribing, keyboard devices, finger manipulation; reservations agent (238.367-018), bricklayer (861.381-018).

(d) Performing technical or related activities; pictorial materials, patterns or related devices, measuring devices; petroleum engineer (010.061-018), kitchen supervisor (310.137-014).

(e) Performing service or related activities; serving or catering; entertaining, supervises nonemployees; music teacher (152.021-010), instrument mechanic (710.381-042).

(f) Regular vs. irregular working schedules; typical day hours, regular hours, variable shift work (-); secretary (201.362-030), air-traffic-control specialist (193.162-014).

(g) Performing routine or repetitive activities; specified work pace, repetitive activities, hourly wage; yarn winder (681.685-154), experimental psychologist (045.061-018).

(h) Being aware of work environment; foot-operated controls, continuous, powered highway or rail vehicles, visual differentiation; motor-grader operator (850.663-033), executive chef (313.131-026).

(i) Engaging in physical activities; walking or running, kneeling or stooping, level of physical exertion; maintenance cement

mason (844.364-010), commercial airplane pilot (196.263-014).

(j) Supervising, directing, or estimating; supervision of non-supervisory personnel, direction of supervisory personnel, powered mobile equipment; stationary-engineer supervisor (950.131-01), ordnance artificer (632.261-018).

(k) Public or consumer contacts; sales personnel, buyers, commission; door-to-door sales representative (291.357-010), instrument shop supervisor (722.131-010).

(l) Working in an unpleasant, hazardous, or demanding environment; awkward or confining work space, improper illumination, high temperature; rock contractor (939.281-010), tube tester (726.684-026).

(m) Optional apparel and nontypical work schedule; apparel style optional, informal attire, irregular work; grain farmworker (401.683-010), firebrick and refactory tile bricklayer (861.381-026).

3. Census data about the aggregate characteristics of workers in each detailed (3-digit) census occupation. The characteristics used were:

(a) Median age for workers employed in an occupation, separately for each sex.

(b) Mean years of schooling completed for persons in the experienced labor force who reported this as their current or most recent occupation.[10]

(c) Percentage of persons in the experienced civilian labor force with this occupation who are men.

(d) Percentage of workers employed in an occupation who are black.

In some analyses percentage women black and percentage men black are used instead of this composite index.

4. Indicators of occupational rewards include the following:

(a) Median male income, based on 1970 census data.

(b) Median female income, based on 1970 census data.

(c) Prestige based on Temme's (1971) work.

Analyses

Analyses are of two types. First, the content of the clusters (with N's of five 3-digit census occupations or more) are described by reporting means and standard deviations for the various measures. Second, a series of multiple discriminant analyses were used to examine the ability of groups of occupational and worker characteristics to discriminate among the clusters, and to describe the differences among the clusters in multivariate terms. Discriminant analyses proceeded in a hierarchical fashion to examine the incremental validity of personal characteristics (age, sex, race, and education) in discriminating among the clusters beyond the extent to which they can be discriminated using job analysis information alone. To make the implications of these complex discriminant analyses as concrete as possible, as a final step classificatory functions derived as part of the discriminant analyses were used to "predict" cluster membership based on job analysis and worker characteristics. The outcomes of this classificatory procedure are expressed in terms of the percentage of occupations correctly assigned to clusters, and by using Cohen's (1960) kappa.[11]

Results

Mean scores on the four scales measuring job content based on the DOT occupational ratings are shown in Table 1 for clusters including five or

more census occupations. Corresponding means for occupational rewards and personal characteristics of workers are shown in Tables 2 and 3. Inspection of these tables implies that these mobility-based clusters are related to occupational differences in work performed, traits presumably required, worker characteristics, and occupational rewards. In many cases the differences among the clusters are very large relative to the within-cluster standard deviations.

Insert Tables 1, 2 and 3 About Here

Results of discriminant analysis using the four scales measuring occupational characteristics as discriminatory variables for clusters with 10 or more census occupations are shown in Table 4. In this table the columns headed "d" show standardized discriminant function coefficients. Columns headed "r" show the correlation between each discriminatory variable and discriminant function scores computed across occupations. These correlations are provided as an aid in interpreting the discriminant functions. These results imply that cluster membership is strongly related to job content as assessed by these four scales, and one interpretation of the results is that cluster membership is powerfully related to occupational level.[12]

Insert Table 4 About Here

The results of a discriminant analysis in which worker characteristics are used as discriminatory variables are shown in Table 5. In this case only four (of a potential 6) discriminant functions were significant. This table demonstrates that cluster membership is also strongly related

to worker characteristics. The most powerful relationship is with a discriminant function that may be interpreted as educational level (function 1). A function defined by sexual composition (function 2) strongly discriminates the clusters; and a function defined by racial composition (function 3) is a moderately good discriminator.

Insert Table 5 About Here

Both job and worker characteristics are combined in a discriminant analysis for which results are shown in Table 6. Seven (of a possible 10) discriminant functions are significant. Although the last two functions (at least) are trivial in a substantive sense, they are shown for completeness. The first discriminant function could, if reflected, be regarded as implying that occupational and educational level is a potent discriminator among the clusters. Occupations scoring high on this function (if reflected) involve substantive complexity and employ highly educated workers. Low scoring occupations involve motor skills, and tend to employ relatively many black workers. A high-scoring occupation on the second most useful discriminant function employs mostly male workers. The third function is related to physical demands, and the fourth to racial composition. The interpretation of the three remaining discriminant functions is unclear, and they share relatively little variance with cluster membership.

Insert Table 6 About Here

When classificatory functions are used to assign occupations to clusters using several different subsets of discriminatory variables, the results presented in Table 7 are obtained. The first row in this table shows the

results of assignment to clusters based solely on the four DOT-based job content scales. It shows that 51% of occupations are correctly classified into their clusters, and the kappa of .46 means that 46% of the greater-than-chance possible assignment has occurred. The next set of results show how efficiently worker characteristics assign occupations to groups. Using information only about mean years of schooling of an occupation's incumbents results in the correct assignment of 39% of the occupations (κ = .31). All personal characteristics combined correctly classify 61% of occupations to clusters (κ = .56). The bottom panel in Table 7 shows the increments to classificatory efficiency when personal characteristics of workers, and finally occupational rewards, are added to job content estimates in predicting cluster membership. Using mean worker education level does not increase the efficiency of classification. When race, sex, and age are added, however, the efficiency of classification markedly increases. The increase in kappa (.48 to .62) is large in relation to the standard errors. Finally, adding occupational rewards increases the efficiency of classification still further.

Insert Table 7 About Here

Although the DOT is a comprehensive source of occupational information, it is based on observer judgment for establishing ratings. Consequently, analyses that parallel those just presented but which are based on an independent and relatively objective source of occupational information are also useful. Means and standard deviations for the thirteen overall dimension scores from the PAQ are shown in Table 8 for clusters with five or more census occupations. As with Table 1, marked differences among the

clusters are evident.

Insert Table 8 About Here

The results of a discriminant analysis using these PAQ dimension scores as discriminatory variables are shown in Table 9. Only 6 of the possible 13 discriminant functions were significant, and only 4 of these have relatively clear interpretations. As with the discriminant analysis using scales derived from the DOT, the first and most powerful function is related to occupational level. The second (if reflected) is defined by service rather than technical activities. The third is related to public contacts, and the fourth to responsibility and physical and technical activities.

Insert Table 9 About Here

Results for personal characteristics that parallel the earlier (Table 5) analyses, except that they are performed using only occupations for which PAQ dimension scores were available, are shown in Table 10. All four discriminant functions closely parallel the functions derived in the earlier analysis, but all are reflected. It is reassuring to find this similar pattern in the more restricted sample of occupations for which PAQ data were available.

Insert Table 10 About Here

The results of a discriminant analysis using PAQ dimensions and worker characteristics as discriminatory variables are shown in Table 11.

There are two potent discriminant functions that seem readily interpretable. The first is related to occupational level, and the second to technical vs. service activities, and to racial and sexual composition of the occupations.

Insert Table 11 About Here

The incremental efficiency obtained when worker characteristics, and then rewards, are added to the PAQ job dimension data, to assign occupations to clusters is shown in Table 12. When only the PAQ data are used to "predict" cluster membership, 48% of occupations are correctly assigned ($\kappa = .44$). Adding information about years of schooling for the average worker increases the hit rate to 54% ($\kappa = .50$). Adding other personal characteristics (information about the race, sex, and age of workers in the occupation) increases the efficiency of assignment considerably--64% hits, $\kappa = .60$. Finally, adding occupational rewards (prestige and income earned) increases further the percentage correctly classified and the kappa. The successive increases in kappa are large in relation to the standard errors.

Insert Table 12 About Here

Discussion

This report has a twofold purpose: (a) to explore the occupational content of a mobility-based occupational classification to learn about the structure of occupational transfers in the U.S. economy, and (b) to critically examine the potential of a mobility-based classification scheme for use in placement. The report suffers from some limitations in serving these objectives. The major limitations appear to be the following:

1. No unequivocally comprehensive and valid source of information

about the characteristics of jobs that are relevant to the transferability of skills exists. In this research we have used archival job analysis data from the fourth edition of the DOT and from the PAQ to describe job content. The first source is the only available source of information about the job content of the U.S. economy that aims to be comprehensive. Limitations of the coverage, content, and psychometric properties of the DOT data are elaborated elsewhere (Cain & Green, 1980; Miller et al., 1980). The PAQ appears to represent the state of the art in assessing the major dimensions of jobs in worker-oriented terms, and fortunately the PAQ archives now contain multiple job descriptions that can be linked with most census occupations. The major limitations here are that these data were not available for all the census occupations, and that the PAQ instrument (as is also true of the DOT ratings) may be somewhat better at discriminating among the characteristics of production occupations than of high-level technical, service, managerial, or professional occupations.

2. As a practical matter, the census occupation was the basic unit of classification and aggregation. This provides a limitation for the original clustering and for subsequent analyses. In many cases the census occupations might profitably be disaggregated. This limitation is unavoidable because social statistics about workers are available only at this level.

3. In assessing the incremental utility of the social characteristics of workers in describing the clusters beyond that possible using the job analysis data, two limitations are inherent. The first is that the job analysis data available may not comprehensively describe job content in terms relevant to explaining mobility. The second is that these social characteristics of workers may be related to job-relevant skills or dispositions, and their utility therefore may incorporate explanatory elements that are <u>not</u> irrelevant to transferability of skills.

A consequence of these limitations is that the present results are suggestive only. They should not be regarded as providing precise estimates of the extent to which barriers or systematic patterns in occupational mobility are related to irrelevant social characteristics, bias, and so forth. Despite these limitations the results are highly suggestive. They serve to provide a description of patterns in occupational mobility, and they have implications for the search for occupational classifications for use in placement. The following paragraphs discuss some of the more salient features of the results and speculate about their implications for placement research.

The strong statistical relations between occupational clusters based on mobility and the completely independent descriptions of occupations derived from the Employment Service (DOT) job analysis data and the worker-oriented (PAQ) job analysis data are important results. The finding that four discriminant functions are useful in discriminating among the mobility-based occupational clusters using the scores based on DOT ratings implies that all four of those scales convey useful information. Discriminatory power would be lost if there were fewer. The finding that six discriminant functions are useful in discriminating among the clusters implies that fewer than 13 component scores could result in the same degree of efficiency in classifying occupations. (This does not, of course, imply that a larger number of dimensions lack utility for some other purposes.) Using either the four scales based on DOT ratings or the PAQ overall dimension scores, a substantial degree of predictive efficiency is attained. The high percentages of correct classification (51% and 48%, respectively) and kappas (.46 and .44) imply a strong association between patterns of job content and patterns of actual mobility of workers among jobs. One interpretation of these results is that these job analysis data represent dimensions of occupational content that are related to transferability of

skills. Other interpretations--involving, for example, worker preferences or employer dependence on irrelevant credentials--are also possible, however.

The observation that the mobility-based clusters are also related to worker demographic or social characteristics is also important. Cluster membership is especially strongly associated with average years of schooling and sexual composition of the occupations, although the racial composition of the occupation is also related to cluster membership. Indeed, these personal characteristics, taken together, are better predictors of the cluster membership of an occupation than either of the two kinds of job analysis data used. This outcome underscores the need for caution in assuming that occupational mobility usefully reflects the transferability of skills. There is at least as much reason to assume that occupational transfers reflect employer preferences or biases (Noland & Bakke, 1949), personal preferences or the limited horizons of workers (Gottfredson, Holland, & Gottfredson, 1975), or other characteristics of workers that may be either related or unrelated to transferable skills.

The results imply that even when the best available descriptions of the job content of occupations and information about the educational level of workers are used, a large increase in the efficiency of classification of occupations to mobility-based categories results by using the sex, race, and age composition of occupations as well. This outcome is a sharp warning of the potential hazards in using a classification of occupations based on patterns of the actual movement of workers among jobs in the labor market. This need for caution, duly noted by the Committee on Occupational Classification and Analysis (Miller et al., 1980), is dramatically illustrated by these results.

Occupational segregation by sex and to a lesser degree race are

phenomena with major social implications. The median earnings for year round full-time women workers in 1977 was 59% that of men's--$8,618 vs. $14,626 (U.S. Bureau of the Census, 1979). A large part of this earnings gap between men and women appears attributable to their employment in different occupations. In 1979, 80% of clerical workers were women, whereas only 24% of managers and administrators (except farm), and 6% of craft and kindred workers were women (U.S. Department of Labor, 1980). Because pay rates differ in different occupations, and because women are concentrated in lower paying occupations than are men, they earn less.

The use in placement or counseling of a classification which disproportionately directed women into lower paying occupations bears scrutiny to ensure that it is based on the actual preferences or job-related talents of the individuals involved to avoid needlessly prepetuating the income gaps among social groups. The present results imply that the mobility-based classification examined here has that potential. For example, clusters 40 (secretaries, stenographers, typists, dental assistants, and flight attendants) and 81 (maids, health aids, nursing aids and orderlies, housekeepers, and child care workers) employ mostly women and are relatively poorly paid. Note that although women earn less than men in every cluster in Table 2, the differences among clusters in earnings overshadow these differences. A classification such as the mobility-based classification considered here has potential problems if used in placement, because personal characteristics including sex, race, and age of an occupations workers are related to cluster assignment beyond the extent to which

this can be accounted for by available job analysis information. The results do not demonstrate that the mobility-based clusters therefore necessarily incorporate inappropriate or biased labor market practices, but they do imply that this is a clear possibility--the moreso because the increase in classificatory efficiency obtained when social characteristics of workers are added to job analysis information in predicting cluster membership is large.

A classification based primarily on observed transfers of workers among jobs will in general be likely to show associations with social characteristics of workers unless explicit steps are taken to prevent such associations in defining the basis of the clustering. Even then, there appears to be no clear way to separate appropriate from inappropriate associations between clusters and the social characteristics of workers.

A more straightforward way to create classifications for use in placement is to base classification more directly on the transferability of skills by using measures of job-related knowledge, skill, and temperaments that persons have and measures of the kinds of knowledge, skill, and temperaments that are demonstrably related to performance, persistence, or satisfaction on the job.[13] This approach accords with the prevalent approach to occupational classification in industrial and counseling psychology (e.g., Shaw, DeNisi, & McCormick, 1977; Dawis, Lofquist, Henley, & Rounds, 1979) more closely than it does with an attempt to build classifications on the basis of observed patterns in mobility. This latter only indirectly gets at transferbility. It focuses on transfers, however they arise.

Despite these drawbacks of mobility-based clusters, the analysis of mobility has research potential. The regularities in mobility summarized by the classifications created by Dauffenbach (1973) and by Harrigan and Turner (1980) have heuristic value in raising the question of how the regularities they make apparent came about. The present research is a first step in accounting for these regularities. It shows that patterns of mobility are related to (a) the content of the jobs, (b) the level of the jobs, (c) sex and race. This raises a host of questions for future research: why are patterns in mobility associated with sex beyond the extent to which they can be accounted for by existing job analysis information? Are important dimensions of jobs that are related to transferability not now measured? Do worker preferences help to explain these patterns? Employer practices?

Finally, the present results can be used to provide evidence about the construct validity of job analysis information. Throughout most of this report we have written as if we were using job analysis information as a way of evaluating the mobility-based clusters. But the results can also be taken as evidence of the validity of the job analysis information. In the discriminant analyses, one can think of the occupational clusters as a set of dummy variables in a canonical analysis sense. The canonical correlations shown are correlations between composites formed of these dummy variables and composites formed of the job analysis data. Many of these correlations are impressive in size, providing impressive evidence of validity for both the PAQ and DOT-based measures. Four discriminant functions (all that are possible) are useful with the four DOT-based scales, but six functions were useful with the thirteen PAQ

composite scales. This implies that more dimensions (at least two) than the four assessed by the DOT-based scales are necessary to account for differences among clusters. In other words, despite their impressive ability to discriminate occupational groups based on patterns in transfer of workers, the four DOT-based scales are not comprehensive. More work to determine the number of job dimensions required to account for mobility and their content seems worthwhile.

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Footnotes

[1] Pearlman (1980) has described the development of these classifications as "essentially rational" (p. 13), because they involve judgments about the overall nature of the jobs to be grouped.

[2] Substitutability within categories has often implicitly been the basis of the evaluation of psychological and other occupational classifications. See Roe, Hubbard, Hutchinson, and Bateman (1966); Gottfredson (1976, 84-85); Turner (1979). Economists are aware, of course, that factors other than job content per se influence substitutability of labor. Labor supply is sometimes assumed to be determined by peoples' decisions to "invest in human capital" (e.g. to increase their productivity potential by increasing their skills or educational level) in ways that develop human resources differentially (Kelley et al., 1975, Chap. 1), and by demographic variables such as marriage and family size patterns and the age composition of populations (Oppenheimer, 1969; U.S. Department of Labor, 1975).

[3] Dauffenbach (1973) produced cluster solutions of four types, with each of the four types represented by two solutions--one with altered diagonals in the mobility matrix and one with unaltered diagonals. He analyzed matrices involving recruitment rates (or ingressive models) and transition rates (or egressive models), and he used both city-block and Euclidean distance metrics. See his original report for details and a discussion of the alternative models. In general,

however, the egressive models involved the probability of transitions of the form

$$p_{ij} = n_{ij}/\Sigma n_{ij} \quad ,$$

where j takes values 1 to the number of occupations. The ingressive models involved matrices of recruitment rates with elements

$$r_{ij} = n_{ij}/\Sigma n_{ij} \quad ,$$

when $i \neq j$ and i takes values 1 to the number of occupations plus 1 (to allow for recruitment from non-work status); when $i = j$, $r_{jj} = 0$. Dauffenbach used complete linkage clustering.

Hartigan and Turner (1980) clustered a different transition matrix, and they used single linkage clustering. (They also provide a brief critique of Dauffenbach's methods, as well as their own.) They clustered a distance matric with elements $d_{ij} = 1/\min(t_{ij}, t_{ji})$, where

$$t_{ij} = \frac{n_{ij}N}{n_{i\cdot}n_{\cdot j}} \quad ,$$

and diagonal cells are ignored.

[4] Hartigan and Turner (1980) used detailed mobility tables described by Somers and Eck (1977) rather than the public use tapes.

[5] The clustering used was based on Dauffenbach's P matrix (see footnote 4) using a city-block metric and retention rates in the diagonal (his cluster configuration I). The distance metric for this clustering was

$$d_{ij} = \Sigma_k(|p_{ik} - p_{jk}|) \quad .$$

In defining the solution we examined, all agglomerations with a cluster value of 1.8002 of lower were used.

[6] Use was made of the April 1971 Current Population Survey in which respondents' occupations were coded using both the Census three-digit codes and the third edition DOT codes. A map relating third to fourth edition DOT codes was used to add fourth edition DOT codes to this tape (excluding in the process 6,984 of the 60,441 cases for which mapping was not possible). Then the records were aggregated to the 1970 census 3-digit categories, and the worker traits and worker functions were factor analyzed. Because not all 3-digit census occupations were represented in the file, values on the factors were imputed using judgment for some occupations. See Appendix F of the report (Miller et al., 1980) for details. In preparing to use these scores in the present research, we used a different method of imputing scores for the missing census occupations. We attempted to identify DOT occupations that represented the missing census occupations using the Classified Index (U.S. Bureau of the Census, 1971) and the DOT as references. Then we used a computer tape of the DOT worker traits and functions data to aggregate traits and functions for these occupations at the census code level. We scored these aggregate values in the same way as they were scored for other occupations, and we averaged the earlier researcher's imputed scores with those created in this way, except that when this appeared inappropriate--as when an apprentice received a higher score than a journeyman--the original score was not altered for that occupation. A table showing the values used is available from the authors.

[7] Because these scales are new, and their psychological meaning may be unclear, analyses reported in the Appendix use the data, people, things, GED, and SVP ratings from the third edition of the DOT. Although these supplementary analyses may be of some interest, they are flawed because the ratings of occupations in the third edition may have underestimated the worker functions rating for work done mainly by women (Miller et al., 1980). Any such systematic differential related to sex composition of an occupation would tend to make occupational characteristics appear to be more powerful discriminators among occupational groups than would unbiased occupational ratings. The source of these third edition ratings is Temme (1975).

[8] We are grateful to Robert Mecham of PAQ Services, Data Processing Division, P.O. Box 3337, Logan, Utah 84321 for making these proprietary data available to us in aggregated form. Without access to these archives this research could not have been done.

[9] Adapted from Meachem, McCormick, and Jeanneret (1977b).

[10] A weighted composite of years of schooling reported by the census bureau separately for men and women was used.

[11] The standard errors for kappa shown in the tables are based on the corrected formula provided by Fleiss, Cohen, and Everitt (1969). Kappa is calculated as follows:

$$\kappa = \frac{p_o - p_c}{1 - p_c}$$

where p_o is the sum of the proportions of cases correctly assigned and

p_c is the expected number correctly assigned given the marginal distributions. Kappa may be interpreted as the proportion of greater-than-chance possible agreement which is observed to occur.

[12] Appendix tables show group centroids for occupational clusters for each set of discriminant analysis results. These tables are helpful in interpreting the results.

[13] This appears most appropriate for jobs with long training times or that require specialized skills or knowledge. It appears likely that basing classifications on more general abilities related to performance or persistence may be useful for many occupations, especially those with short training times (cf. Occupational and Career Analysis and Development Branch, 1977).

Table 1

Means and Standard Deviations for Factor-Based Scales for Department of Labor Occupational Analysis Data

		Substantive complexity		Physical demands		Motor skills		Undesirable conditions	
Cluster	N	M	SD	M	SD	M	SD	M	SD
5	5	5.78	0.61	6.74	2.88	1.02	1.35	0.02	0.04
9	30	7.99	0.69	2.85	0.86	0.36	0.78	0.00	0.00
10	10	6.19	1.42	3.95	1.82	1.19	0.93	0.00	0.00
12	5	7.30	0.78	8.38	1.51	0.52	0.48	0.00	0.00
14	16	5.64	1.01	3.13	0.54	0.30	0.38	0.01	0.02
30	6	7.55	0.82	3.03	0.56	0.10	0.09	0.00	0.00
34	6	7.63	1.78	5.27	1.32	2.83	2.49	0.52	0.90
35	11	6.40	1.18	5.60	1.42	1.57	2.22	0.05	0.07
36	15	7.05	1.43	4.75	1.72	0.51	0.36	0.01	0.05
37	6	7.67	0.75	7.28	0.71	1.20	0.84	0.07	0.08
38	5	8.46	1.05	5.90	1.19	1.50	1.47	0.34	0.71
40	7	4.39	1.24	6.81	1.74	1.06	2.80	0.00	0.00
41	19	3.33	0.87	5.34	1.23	0.17	0.24	0.02	0.07
42	17	2.66	1.57	4.35	1.77	1.75	1.81	0.06	0.11
43	11	6.05	1.34	2.85	0.60	0.97	1.45	0.01	0.03
51	6	3.33	2.28	5.15	0.72	5.78	1.83	0.08	0.12
52	5	4.82	0.43	7.04	0.61	5.68	1.19	0.48	0.31
55	36	2.10	0.78	5.26	1.04	4.29	2.59	0.92	1.23
58	5	2.34	0.27	5.20	1.15	3.04	1.01	0.00	0.00
59	11	2.13	1.68	4.15	1.22	1.31	1.18	1.56	1.81
61	7	1.57	0.52	5.70	0.55	1.03	0.38	0.83	0.94
64	17	2.01	0.95	5.43	0.93	2.05	2.21	0.34	0.39
70	8	3.30	1.19	6.55	0.99	1.39	0.92	0.42	0.96
71	7	4.19	0.61	7.30	0.45	0.67	0.36	0.37	0.67
72	5	5.18	0.76	7.24	0.15	7.04	0.76	0.08	0.11
75	37	3.97	1.24	6.13	1.39	3.73	2.71	0.28	0.54
76	14	4.39	0.43	7.14	0.93	6.51	2.60	0.49	0.87
81	7	2.36	1.94	3.80	1.05	2.16	1.43	0.09	0.19

Table 2

Means and SD's for Occupational Rewards for Clusters

		Earnings					
		Men		Women		Prestige	
Cluster	N	M	SD	M	SD	M	SD
5	5	8264	3411	5045	864	49.42	7.70
9	30	11782	2323	6660	1674	70.23	4.72
10	10	5622	2367	3350	1983	48.61	11.24
12	5	13721	3832	5235	1058	64.74	3.22
14	16	10279	1818	5042	1432	49.14	7.35
30	6	11308	2557	5813	1646	63.60	7.70
34	6	12104	2530	4523	1173	6[illegible].38	10.94
35	11	8812	2153	5606	1366	52.79	9.35
36	15	11174	2236	7233	1417	59.09	9.53
37	6	12403	2189	8682	2522	62.08	7.58
38	5	13310	758	11602	2233	66.32	3.09
40	7	7192	2110	4814	896	44.64	3.85
41	19	6458	1203	4239	543	38.22	4.30
42	17	3806	2410	1801	921	21.74	11.05
43	11	9470	2225	5325	1638	51.60	10.18
51	6	4360	2098	2158	1092	25.28	12.55
52	5	7887	1330	6948	2064	39.28	2.38
55	36	6143	1700	3913	1334	25.58	7.14
58	5	6322	804	3271	1287	28.00	2.77
59	11	3954	2469	2236	907	21.28	13.64
61	7	5010	955	3680	836	22.51	4.93
64	17	6381	1047	3611	536	27.76	4.93
70	8	7863	850	5099	629	35.45	3.81
71	7	7980	1854	4405	397	40.51	3.83
72	5	8433	1148	6253	279	42.04	1.54
75	37	7080	1516	4539	1469	36.61	6.77
76	14	6546	1318	5094	1798	34.92	3.56
81	7	3815	1568	2360	1029	27.40	10.97

Table 3

Means and Standard Deviations of Personal Characteristics of Workers in the Clusters

		Age				Years Schooling							
		Men		Women		Men		Women		Prop Men		Pct Black	
Cluster	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
5	5	36.52	6.44	34.08	6.34	13.88	.99	13.78	1.04	.23	.16	11.54	6.44
9	30	37.63	3.07	36.93	4.59	16.93	.35	16.88	.32	.71	.21	3.09	2.37
10	10	31.98	6.39	39.02	6.10	14.75	1.61	14.33	1.59	.38	.21	10.75	7.97
12	5	48.76	6.79	50.07	11.08	16.38	.18	16.40	.61	.86	.16	1.18	1.40
14	16	41.72	3.05	39.81	6.31	13.40	1.13	12.59	.23	.84	.11	1.67	1.30
30	6	38.70	5.53	39.48	4.01	15.92	1.13	15.48	1.24	.77	.12	2.45	1.03
34	6	40.67	2.52	39.17	3.14	16.23	1.28	13.55	1.99	.91	.07	2.52	1.93
35	11	36.18	3.95	33.11	4.35	14.34	1.84	14.20	1.88	.67	.30	4.62	2.05
36	15	34.89	3.35	33.69	5.26	14.77	1.62	14.35	1.45	.83	.11	3.03	1.72
37	6	38.33	3.58	36.98	2.82	15.37	1.50	14.73	1.24	.94	.09	1.50	.58
38	5	40.26	1.01	34.90	14.71	16.48	.26	16.30	.42	.99	.00	.86	.58
40	7	36.07	5.30	30.79	4.30	12.90	.41	12.83	.53	.03	.02	6.61	4.18
41	19	33.37	6.09	35.62	4.43	12.63	.16	12.48	.08	.24	.15	9.03	3.60
42	17	31.86	10.13	32.67	8.14	11.82	1.13	12.16	.36	.55	.31	13.34	15.63
43	11	41.70	7.15	43.61	4.14	13.87	1.06	12.65	.10	.66	.19	3.05	2.82
51	6	40.58	11.00	45.50	4.60	10.73	1.16	11.35	1.24	.86	.14	6.73	6.21
52	5	43.36	2.85	44.47	4.48	11.54	.32	11.57	.15	.98	.01	4.62	1.57
55	36	38.51	6.09	39.01	4.37	10.33	.65	10.55	.61	.92	.09	14.77	6.29
58	5	43.78	6.36	40.16	2.76	11.20	.51	11.78	.47	.91	.11	14.38	5.11
59	11	32.60	11.83	40.55	8.75	10.99	.79	10.88	.75	.47	.26	13.49	8.15
61	7	38.27	2.66	41.50	2.48	9.39	.66	9.93	.57	.52	.24	13.89	4.19
64	17	36.42	3.98	41.77	4.11	11.02	.85	10.75	.50	.57	.26	11.57	4.75
70	8	38.55	6.56	42.06	3.32	11.65	.52	11.04	.40	.93	.07	6.24	2.23
71	7	34.63	8.36	38.45	1.90	12.27	.14	12.12	.24	.89	.09	4.51	1.43
72	5	32.46	6.17	34.37	3.57	12.42	.11	12.22	.22	.98	.01	3.50	.44
75	37	39.32	8.79	39.32	4.86	11.68	.97	11.60	.77	.93	.06	5.93	3.50
76	14	34.47	9.88	41.25	5.39	11.24	.89	11.21	1.01	.97	.03	10.25	7.83
81	7	36.20	11.92	42.80	9.19	11.71	1.03	11.39	.94	.14	.10	18.96	9.50

Table 4

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Occupational Analysis Scales from Department of Labor Data

Discriminatory variable	Fn. 1		Fn. 2		Fn. 3		Fn. 4	
	r	d	r	d	r	d	r	d
Substantive complexity	.92	.95	.38	.42	-.20	.00	-.25	-.19
Physical demands	-.44	-.54	.57	.40	-.70	-.71	-.37	-.36
Motor skills	-.44	-.18	.68	.75	.44	.50	.32	.42
Undesirable working conditions	-.29	-.04	.06	.06	.44	.44	-.66	-.92
Percent of variance		80.75		11.61		5.54		2.09
Canonical R		.92		.67		.52		.36
Λ before removing this function		.05**		.35**		.63**		.87*

Note. N for discriminant analysis is 210. N's for correlations of discriminatory variables with discriminant scores range from 375 to 427.

* $p < .01$

** $p < .001$

Table 5

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Personal Characteristics

Discriminatory variable	Fn. 1		Fn. 2		Fn. 3		Fn. 4	
	r	d	r	d	r	d	r	d
Median employed male age	.14	.10	-.33	-.24	-.06	-.36	.50	.00
Median employed female age	.25	.02	-.09	.00	.29	.46	.93	.91
Years of education[a]	-.98	-1.00	-.27	-.17	-.06	.34	-.04	.00
Percentage male[b]	.16	.28	-.96	-.90	-.07	-.18	-.13	-.16
Percentage black (men)[c]	.45	.10	.36	.06	.81	.79	-.20	-.40
Percentage black (women)[c]	.40	-.15	.18	-.11	.70	.26	.10	.24
Percent of variance		71.11		19.81		4.52		3.10
Canonical R		.93		.81		.55		.48
Λ before removing this function		.02*		.17*		.48*		.68*

Note. N for discriminant analysis is 210. N's for correlations of discriminatory variables with discriminant scores range from 375 to 427.

* $p<.001$

[a] A weighted composite of men's and women's schooling for persons in the experienced civilian labor force.

[b] Experienced civilian labor force.

[c] Employed workers.

Table 6

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Occupational Analysis Scales from Department of Labor Data and Personal Characteristics

Discriminatory variable	Fn 1		Fn 2		Fn 3		Fn 4		Fn 5		Fn 6		Fn7	
	r	d	r	d	r	d	r	d	r	d	r	d	r	d
Substantive complexity	-.86	-.54	.40	.38	.02	-.28	-.21	.14	-.34	-.99	-.11	.01	-.02	.52
Physical demands	.33	.23	.10	.00	.68	.92	-.41	-.26	-.22	-.08	-.18	-.21	-.32	-.49
Motor skills	.47	.09	.37	.20	.26	.30	.24	.33	.01	-.04	.28	.57	.21	.14
Undesirable working conditions	.31	.05	.07	.06	-.05	-.14	.24	.15	.02	-.05	-.46	-.70	-.05	-.08
Median employed male age	.10	.19	.30	.13	-.27	-.11	-.03	-.33	.06	.42	.34	.47	-.53	-.34
Median employed female age	.22	.05	.10	.02	-.38	-.18	.42	.58	-.18	-.25	.31	.11	-.60	-.58
Years of education[a]	-.96	-.61	.20	-.07	.21	.66	-.11	.20	.18	.75	-.13	.01	-.15	-.54
Percentage male[b]	.14	.25	.94	.82	-.01	-.02	-.18	-.05	.26	.32	-.23	-.26	.02	.07
Percentage of men black[c]	.45	.01	-.32	.05	.18	.41	.74	.63	.20	.28	.36	.56	.17	.43
Percentage of women black[c]	.40	-.14	-.16	.07	.04	.14	.62	.12	-.05	-.32	-.02	-.60	-.14	-.46
Percent of variance	65.23		17.63		6.63		3.98		2.43		1.93		1.45	
Canonical R	.94		.82		.67		.57		.48		.44		.39	
Λ before removing this function	.01**		.06**		.18**		.33**		.49**		.63**		.78*	

Note. N for discriminant analysis is 210. N's for correlations of discriminatory variables with discriminant scores range from 375 to 427.

*p<.01

**p<.001

[a]A weighted composite of men's and women's schooling for persons in the experienced labor force.

[b]Experienced civilian labor force.

[c]Employed workers.

Table 7

Efficiency of Various Sets of Discriminatory Variables in Classifying Occupations to Known Mobility-Based Groups (N=210 Occupations)

Set of discriminatory variables	No. of functions	Pct. correctly classified[a]	K	SE_K
Occupational analysis data (DOT)	4	51.2	.461	.034
Worker characteristics				
Education	1	38.9	.308	.032
Race, sex, and age[b]	4	44.3	.371	.034
All	4	60.7	.558	.034
Occupational analysis data plus				
Education only	5	53.3	.483	.034
All personal characteristics	7	66.0	.623	.033
Personal characteristics and rewards[c]	8	70.9	.677	.032

[a]Prior probalities set proportional to group size.

[b]Percentage male, median male age, median female age, percentage males black, percentage females black.

[c]Rewards include prestige, median male income, and median female income.

Table 8

Means and Standard Deviations of PAQ Overall Dimension Scores for Clusters

Cluster	N	Responsibility		Machines, equipment		Clerical activities		Technical activities		Service activities		Irreg. work schedules		Routine schedules	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
9	6	1.16	0.61	-0.13	0.35	-0.53	0.55	0.07	0.75	0.58	0.88	0.0	0.59	-0.24	0.46
10	8	0.60	0.63	-0.32	0.29	-0.41	0.41	-0.39	0.58	0.83	0.99	-0.08	0.59	-0.31	0.26
14	14	0.67	0.52	-0.69	0.28	-0.08	0.64	-0.02	0.44	-0.53	0.31	-0.28	0.75	0.22	0.32
34	5	0.35	0.51	-0.29	0.54	-0.14	0.37	1.27	0.39	-0.30	0.32	0.29	0.75	-0.51	0.48
35	9	0.48	0.84	0.23	0.71	-0.21	0.61	0.50	0.43	-0.14	0.87	0.10	0.41	-0.19	0.50
36	12	0.44	0.46	-0.11	0.58	0.02	0.42	0.57	0.46	-0.57	0.30	0.17	0.33	0.0	0.32
40	7	-0.28	0.40	-0.12	0.56	0.60	0.61	-0.79	0.44	0.59	0.53	0.24	0.54	-0.48	0.41
41	17	-0.46	0.21	-0.36	0.35	0.61	0.37	-0.37	0.28	0.12	0.19	0.14	0.32	0.0	0.30
42	9	-0.05	0.43	-0.32	0.41	-0.32	0.98	-0.05	0.28	0.45	0.51	-0.23	0.70	0.02	0.41
43	11	0.71	0.75	-0.70	0.19	-0.13	0.48	-0.15	0.51	-0.42	0.26	0.11	0.91	-0.04	0.40
55	27	-0.87	0.32	0.24	0.72	-0.81	0.44	-0.17	0.54	-0.03	0.49	-0.32	0.58	0.43	0.63
58	5	-0.36	0.75	-0.28	0.38	0.01	0.53	-0.64	0.79	0.63	0.46	-0.96	0.91	0.46	0.48
59	9	-0.53	0.87	0.31	0.58	-0.47	0.70	-0.24	0.47	1.10	0.33	-1.30	1.14	0.42	0.57
61	5	-1.02	0.13	0.37	0.50	-0.71	0.33	-0.44	0.26	0.54	0.18	-0.32	0.62	1.41	0.51
64	14	-0.64	0.25	0.31	0.46	-0.48	0.50	-0.02	0.56	-0.12	0.31	-0.58	0.72	0.73	0.59
70	8	-0.60	0.34	1.09	0.52	-0.73	0.46	0.06	0.41	-0.51	0.43	-0.16	0.28	0.82	0.52
71	6	-0.28	0.38	1.16	0.75	0.09	0.44	0.44	0.68	-0.01	0.75	0.03	0.47	0.67	0.48
72	5	-0.09	0.26	0.42	0.56	-0.14	0.19	0.45	0.30	-0.95	0.44	-0.12	0.37	-0.27	0.30
75	25	-0.28	0.48	0.42	0.78	-0.12	0.41	0.28	0.44	-0.60	0.34	0.06	0.62	0.14	0.55
76	10	-0.50	0.30	0.64	0.29	-0.35	0.53	0.14	0.60	-0.50	0.46	0.75	0.36	0.16	0.54
81	5	0.65	0.56	0.25	0.92	-0.14	0.57	-0.46	0.71	1.26	1.29	-0.29	0.46	-0.14	0.48

(continued)

Table 8 (continued)

Cluster	N	Environmental awareness		Physical activities		Supervising, directing		Public contacts		Unpleasant, hazardous, environment		Nontypical work schedule	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
9	6	-0.55	0.29	0.17	0.34	0.16	0.43	-0.91	0.57	-0.58	0.20	0.46	0.32
10	8	-0.23	0.40	-0.05	0.47	-0.45	0.49	-0.96	1.15	-0.48	0.22	0.28	0.50
14	14	-0.09	0.40	-0.13	0.57	0.10	0.65	0.95	1.13	-0.23	0.53	0.08	0.78
34	5	0.56	0.82	-0.15	0.62	0.61	0.41	-0.16	0.72	-0.14	0.54	-0.01	0.61
35	9	-0.41	0.50	-0.15	0.45	-0.17	0.46	0.04	0.74	-0.32	0.48	0.08	0.58
36	12	-0.57	0.33	-0.59	0.37	0.21	0.47	-0.35	0.21	-0.03	0.24	-0.35	0.40
40	7	-0.56	0.27	-0.60	0.50	-0.46	0.18	-0.11	0.14	-0.03	0.39	-0.51	0.22
41	17	-0.58	0.15	-0.41	0.35	0.11	0.25	-0.18	0.23	-0.17	0.26	-0.08	0.26
42	9	-0.10	0.31	0.12	0.61	-0.03	0.30	0.46	1.42	-0.34	0.41	0.16	0.29
43	11	-0.13	0.46	-0.54	0.29	0.25	0.64	0.08	0.18	-0.23	0.24	-0.11	0.49
55	27	0.34	1.06	0.08	0.74	0.15	0.68	-0.07	0.53	0.17	0.67	-0.07	0.58
58	5	1.81	0.67	-0.33	0.89	0.03	0.27	-0.03	0.73	-0.46	0.95	0.06	1.08
59	9	-0.97	0.36	0.69	0.30	0.31	0.62	1.93	1.36	-0.13	0.50	-0.40	0.52
61	5	-0.34	0.09	0.06	0.44	-0.02	0.21	0.20	0.24	-0.35	0.34	0.52	0.53
64	14	-0.14	0.60	0.20	0.58	-0.06	0.51	-0.22	0.31	-0.12	0.22	0.09	0.56
70	8	-0.40	0.22	-0.13	0.39	-0.22	0.50	-0.27	0.31	-0.18	0.58	0.16	0.11
71	6	-0.54	0.61	-0.11	0.91	-0.25	0.58	0.17	0.31	-0.40	0.46	0.02	0.58
72	5	0.52	0.64	0.66	0.46	-0.18	0.21	-0.44	0.13	0.62	0.65	-0.05	0.36
75	25	0.04	0.44	0.46	0.41	-0.02	0.58	-0.35	0.32	0.34	0.68	-0.20	0.47
76	10	0.12	0.56	1.13	0.49	-0.08	0.51	-0.03	0.51	1.00	0.56	-0.58	0.42
81	5	0.07	0.48	0.27	0.41	0.17	0.81	0.19	0.85	-0.34	0.91	0.03	0.91

Table 9

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Occupational Characteristics (PAQ)

Discriminatory variable	Fn 1		Fn 2		Fn 3		Fn 4		Fn 5		Fn 6	
	r	d	r	d	r	d	r	d	r	d	r	d
Responsiblity	0.74	0.74	0.17	0.13	0.11	0.15	0.55	0.66	0.14	0.11	0.06	0.11
Machines, equipment	-0.50	-0.55	0.05	0.06	-0.02	0.01	0.19	0.23	-0.59	-0.59	-0.19	-0.10
Clerical activities	0.30	0.43	0.01	-0.09	0.16	0.22	-0.34	-0.35	-0.37	-0.45	0.28	0.33
Technical activities	-0.03	-0.12	0.52	0.54	0.36	0.26	0.37	0.32	-0.15	-0.05	-0.46	-0.41
Service activities	0.16	0.20	-0.78	-0.84	-0.35	-0.28	0.18	0.19	-0.06	-0.17	0.10	0.09
Irregular work schedules	0.16	0.18	0.27	0.14	0.05	-0.06	-0.15	-0.38	-0.39	-0.46	0.29	0.32
Routine work schedules	-0.42	-0.26	-0.12	-0.13	0.09	0.17	-0.16	0.01	0.34	0.38	-0.15	-0.16
Environmental awareness	-0.32	-0.48	0.28	0.48	-0.20	-0.14	-0.02	0.12	0.38	0.34	0.48	0.56
Physical activities	-0.37	-0.25	-0.06	-0.05	-0.03	-0.08	0.41	0.54	-0.35	-0.22	0.41	0.34
Supervising, directing	-0.10	-0.32	-0.07	-0.20	0.11	0.08	-0.08	-0.10	0.07	-0.28	-0.08	-0.38
Public contacts	-0.10	-0.15	-0.38	-0.39	0.62	0.83	0.03	-0.05	0.08	0.07	0.20	0.32
Unpleasant, hazardous envir.	-0.43	-0.43	0.24	0.14	0.18	0.11	0.01	0.02	-0.15	-0.10	0.22	0.19
Nontypical schedule	0.07	-0.05	-0.03	0.15	-0.41	-0.47	-0.01	-0.16	0.15	-0.01	0.01	-0.00
Percent of variance	43.23		24.3[illegible]		10.35		9.39		5.90		3.04	
Canonical R	0.91		0.8[illegible]		0.72		0.71		0.62		0.49	
Λ before removing this function	0.00**		0.02[illegible]		0.08**		0.16**		0.32**		0.52*	

Note. N for discriminant analysis is 148. N for correlations of discriminatory variables with discriminant scores is 304.

* $p < .01$

** $p < .001$

Table 10

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Personal Characteristics

Discriminatory variable	Fn 1		Fn 2		Fn 3		Fn 4	
	r	d	r	d	r	d	r	d
Median employed male age	-0.16	-0.14	0.23	0.08	0.01	0.36	-0.22	0.29
Median employed female age	-0.23	0.03	0.03	0.09	-0.32	-0.53	-0.81	-0.96
Years of education[a]	0.93	0.94	0.49	0.36	-0.08	-0.41	0.22	0.15
Percentage male[b]	-0.34	-0.49	0.87	0.83	0.06	-0.15	0.02	0.12
Percentage black men[c]	-0.41	-0.26	-0.52	-0.32	-0.70	-0.61	0.36	0.82
Percentage black women[c]	-0.34	0.29	-0.27	0.36	-0.70	-0.47	-0.11	-0.52
Percent of variance	62.30		24.96		6.04		4.44	
Canonical R	0.92		0.82		0.58		0.52	
Λ before removing this function	0.02*		0.13*		0.40*		0.61*	

Note. N for discriminant analysis is 148. N's for correlations of discriminatory variables with discriminatory scores range from 375 to 427.

* $p < .001$

[a] A weighted composite of men's and women's schooling for persons in the experienced civilian labor force.

[b] Experienced civilian labor force.

[c] Employed workers.

Table 11

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Occupational and Personal Characteristics (PAQ)

Discriminatory variable	Fn 1		Fn 2		Fn 3		Fn 4		Fn 5		Fn 6		Fn 7	
	r	d	r	d	r	d	r	d	r	d	r	d	r	d
Responsiblity	0.68	0.48	0.36	0.32	-0.36	-0.31	-0.06	0.06	-0.15	-0.23	-0.18	-0.41	-0.02	-0.06
Machines, equipment	-0.40	-0.33	-0.05	-0.06	-0.06	-0.14	-0.22	-0.26	0.56	0.67	-0.07	-0.05	0.25	0.22
Clerical activities	0.28	0.37	-0.02	0.03	0.28	0.15	0.33	0.39	0.29	0.31	-0.20	-0.21	0.10	0.13
Technical activities	-0.01	-0.18	0.42	0.41	-0.17	0.03	-0.01	-0.04	0.31	0.23	0.27	0.15	0.04	0.13
Service activities	0.25	0.29	-0.67	-0.55	-0.30	-0.51	-0.20	-0.07	0.00	0.02	-0.09	-0.09	-0.41	-0.41
Irregular work schedules	0.11	-0.02	0.20	-0.04	0.24	0.40	0.13	0.20	0.32	0.40	-0.23	-0.21	-0.23	-0.35
Routine work schedules	-0.40	-0.11	-0.16	-0.08	-0.02	-0.15	0.02	-0.04	-0.24	-0.23	0.19	0.23	0.49	0.48
Environmental awareness	-0.34	-0.31	0.24	0.39	0.10	0.12	-0.18	-0.27	-0.36	-0.23	-0.25	-0.37	-0.16	-0.00
Physical activities	-0.30	-0.10	-0.04	0.01	-0.31	-0.33	-0.18	-0.19	0.26	0.19	-0.57	-0.60	0.22	0.24
Supervising, directing	-0.10	-0.23	-0.06	-0.27	-0.06	-0.11	0.05	-0.02	-0.06	0.34	0.19	0.39	0.05	0.05
Public contacts	-0.13	-0.17	-0.23	-0.14	-0.36	-0.44	0.59	0.75	0.00	0.11	-0.06	0.06	-0.12	-0.18
Unpleasant, hazardous envir.	-0.40	-0.37	0.21	0.12	-0.06	-0.09	-0.01	-0.09	0.11	0.12	-0.05	0.04	-0.06	-0.14
Nontypical schedule	0.07	-0.04	-0.05	-0.05	0.10	0.36	-0.26	-0.35	-0.21	-0.04	-0.12	-0.09	0.07	0.04
Median employed male age	-0.13	-0.11	0.14	-0.05	-0.08	0.18	0.08	0.23	-0.08	0.34	0.03	-0.07	0.20	-0.01
Median employed female age	-0.21	0.03	-0.02	0.07	-0.16	-0.25	-0.12	-0.30	-0.41	-0.56	-0.10	-0.02	0.47	0.51
Years of education[a]	0.82	0.70	0.47	0.21	-0.35	-0.27	-0.28	-0.41	0.14	0.14	0.38	0.39	0.06	0.12
Percentage male[b]	-0.43	-0.41	0.77	0.56	-0.34	-0.36	0.01	0.03	-0.14	-0.20	0.19	0.19	-0.16	-0.33
Percentage black men[c]	-0.33	-0.22	-0.51	-0.08	0.23	0.41	-0.36	-0.41	-0.05	-0.27	0.07	0.37	-0.26	-0.29
Percentage black women[c]	-0.28	0.20	-0.37	-0.01	-0.12	-0.55	-0.25	-0.10	0.15	0.49	-0.04	0.02	-0.09	0.09
Percent of variance	50.93		19.40		8.70		8.03		5.01		2.45		2.17	
Canonical R	0.95		0.89		0.79		0.78		0.70		0.57		0.54	
Λ before removing this function	0.00**		0.00**		0.02**		0.05**		0.14**		0.27**		0.40*	

Note. N for discriminant analysis is 148. N's for correlations of discriminatory variables with discriminant scores range from 304 to 427.

* $p<.01$

** $p<.001$

[a] A weighted composite of men's and women's schooling for persons in the experienced labor force.

[b] Experienced civilian labor force.

[c] Employed workers.

Table 12

Efficiency of Various Sets of Discriminatory Variables in Classifying Occupations to Known Mobility-Based Groups (N=148 Occupations)

Set of discriminatory variables	No. of functions	Pct. correctly classified[a]	K	SE_K
Occupational analysis data (PAQ)	6	48.4	.438	.034
Worker characteristics				
Education	1	39.3	.319	.031
Race, sex, and age[b]	3	38.1	.312	.032
All	4	61.5	.569	.034
Occupational analysis data plus				
Education only	6	54.1	.498	.034
All personal characteristics	7	63.5	.597	.034
Personal characteristics and rewards[c]	7	70.9	.679	.032

[a] Prior probalities set proportional to group size.

[b] Percentage male, median male age, median female age, percentage males black, percentage females black.

[c] Rewards include prestige, median male income, and median female income.

Appendix

This appendix contains supplementary tables useful in interpreting results summarized in the text. It also contains the results of some analyses based on third edition DOT ratings.

The third edition results are shown because many readers may be more familiar with the third edition DOT or the worker function ratings than with the new factor-based scales based on the fourth edition DOT ratings used in the text. There is reason to believe that worker function ratings in the third edition systematically assign lower values to work done predominantly by women (Miller et al., 1980). Because the sex composition of occupations is associated with patterns in occupational mobility (see text), there is therefore good reason to believe that interpreting the results for third edition DOT ratings is an especially tricky business because they are possibly inappropriately associated with occupational sex composition.

Table A-1 shows the occupational content of the mobility-based clusters.

Tables A-2 through A-4 show group centroids for clusters in the discriminant analyses involving the fourth edition DOT-based occupational scales.

Tables A-5 through A-7 show group centroids for clusters in the discriminant analyses involving the PAQ overall dimension scores.

Tables A-8 through A-12 show results involving third-edition DOT data. No tables for personal characteristics alone are shown in this set because they are identical to the results for the fourth edition DOT analyses. The two sets of analyses involve precisely the same census occupations.

Table A-1

Occupational Content of Mobility-Based Groups

Cluster number	Census code	Occupational title
1	62	Dentists
2	65	Physicians, medical and osteopathic
3	74	Dietitians
4	76	Therapists
5	80	Clinical laboratory technologists and technicians
	81	Dental hygienists
	82	Health record technologists and technicians
	84	Therapy assistants
	85	Health technologists and technicians, n.e.c.
6	75	Registered nurses
	923	Health trainees
	924	Lay midwives
	926	Practical nurses
7	143	Prekindergarten and kindergarten teachers
8	93	Psychologists
9	102	Agriculture teachers
	103	Atmospheric, earth, marine, and space teachers
	104	Biology teachers
	105	Chemistry teachers
	110	Physics teachers
	111	Engineering teachers
	112	Mathematics teachers
	113	Health specialties teachers
	114	Psychology teachers
	115	Business and commerce teachers
	116	Economics teachers
	120	History teachers
	121	Sociology teachers
	122	Social science teachers, n.e.c.
	123	Art, drama, and music teachers
	124	Coaches and physical education teachers
	125	Education teachers
	126	English teachers
	130	Foreign language teachers
	131	Home economics teachers
	132	Law teachers
	133	Theology teachers
	134	Trade, industrial, and technical teachers
	135	Miscellaneous teachers, college and university
	140	Teachers, college and university, subject not specified
	141	Adult education teachers
	142	Elementary school teachers
	144	Secondary school teachers
	174	Vocational and educational counselors
	240	School administrators, elementary and secondary

Cluster number	Census code	Occupational title
10	32	Librarians
	33	Archivists and curators
	90	Religious workers, n.e.c.
	100	Social workers
	101	Recreation workers
	145	Teachers, except college and university, n.e.c.
	185	Musicians and composers
	330	Library attendants and assistants
	382	Teacher aides, exc. school monitors
	954	Welfare service aides
11	86	Clergymen
12	61	Chiropractors
	63	Optometrists
	71	Podiatrists
	72	Veterinarians
	73	Health practitioners, n.e.c.
13	64	Pharmacists
14	203	Buyers and shippers, farm products
	205	Buyers, wholesale and retail trade
	225	Purchasing agents and buyers, n.e.c.
	231	Sales managers and department heads, retail trade
	233	Sales managers, except retail trade
	245	Managers and administrators, n.e.c.
	260	Advertising agents and salesmen
	261	Auctioneers
	265	Insurance agents, brokers, and underwriters
	271	Stock and bond salesmen
	281	Sales representatives, manufacturing industries
	282	Sales representatives, wholesale trade
	284	Salesmen, retail trade
	285	Salesmen of services and construction
	326	Insurance adjusters, examiners, and investigators
	390	Ticket, station, and express agents
15	216	Managers and superintendents, building
	270	Real estate agents and brokers
16	212	Health administrators
17	56	Personnel and labor relations workers
	223	Officials of lodges, societies, and unions
18	221	Officers, pilots, and pursers; ship
19	165	Embalmers
	211	Funeral directors
20	171	Radio operators
	963	Marshals and constables
	964	Policemen and detectives
	965	Sheriffs and bailiffs
21	213	Construction inspectors, public administration
	215	Inspectors, except construction, public administration
22	426	Dental laboratory technicians
23	164	Air traffic controllers
24	475	Data processing machine repairmen
25	484	Mechanics and repairmen; office machine

Cluster number	Census code	Occupational title
26	163	Airplane pilots
	170	Flight engineers
27	30	Judges
	31	Lawyers
28	190	Painters and sculptors
29	191	Photographers
	645	Photographic process workers
30	91	Economists
	183	Authors
	184	Editors and reporters
	192	Public relations men and publicity writers
	193	Radio and television announcers
	235	School administrators, college
31	92	Political scientists
	94	Sociologists
	95	Urban and regional planners
	96	Social scientists, n.e.c.
32	44	Biological scientists
33	53	Physicists and astronomers
34	25	Foresters and conservationists
	42	Agricultural scientists
	43	Atmospheric and space scientists
	51	Geologists
	52	Marine scientists
	54	Life and physical scientists, n.e.c.
35	24	Farm management advisors
	26	Home management advisors
	45	Chemists
	151	Chemical technicians
	150	Agriculture and biological technicians, except health
	154	Industrial engineering technicians
	155	Mechanical engineering technicians
	175	Actors
	182	Dancers
	194	Writers, artists, and entertainers, n.e.c.
	195	Research workers, not specified
36	3	Computer programmers
	4	Computer systems analysts
	5	Computer specialists, n.e.c.
	13	Industrial engineers
	23	Engineers, n.e.c.
	34	Actuaries
	35	Mathematicians
	36	Statisticians
	55	Operations and systems researchers and analysts
	153	Electrical and electronic engineering technicians
	156	Mathematical technicians
	162	Engineering and science technicians, n.e.c.
	172	Tool programmers, numerical control
	173	Technicians, n.e.c.
	343	Computer and peripheral equipment operators

Cluster number	Census code	Occupational title
37	6	Aeronautical and astronautical engineers
	11	Civil engineers
	12	Electrical and electronic engineers
	14	Mechanical engineers
	152	Draftsmens
	183	Designers
38	10	Chemical engineers
	15	Metallurgical and materials engineers
	20	Mining engineers
	21	Petroleum engineers
	22	Sales engineers
39	2	Architects
40	370	Secretaries, legal
	371	Secretaries, medical
	372	Secretaries, n.e.c.
	376	Stenographers
	391	Typists
	921	Dental assistants
	931	Airline stewardesses
41	301	Bank tellers
	303	Billing clerks
	305	Bookkeepers
	311	Clerical assistants, social welfare
	325	File clerks
	332	Mail handlers, except post office
	341	Bookkeeping and billing machine operators
	342	Calculating machine operators
	344	Duplicating machine operators
	345	Key punch operators
	350	Tabulating machine operators
	355	Office machine operators, n.e.c.
	360	Payroll and timekeeping clerks
	362	Proofreaders
	364	Receptionists
	375	Statistical clerks
	385	Telephone operators
	394	Miscellaneous clerical workers
	395	Not specified clerical workers
42	180	Athletes and kindred workers
	262	Demonstrators
	264	Hucksters and peddlers
	266	Newsboys
	283	Sales clerks, retail trade
	310	Cashiers
	314	Counter clerks, except food
	315	Dispatchers and starters, vehicle
	333	Messengers and office boys
	383	Telegraph messengers
	932	Attendants, recreation and amusement
	933	Attendants, personal service, n.e.c.

Cluster number	Census code	Occupational title
42	934	Baggage porters and bellhops
	941	Bootblacks
	945	Personal service apprentices
	952	School monitors
	953	Ushers, recreation and amusement
43	1	Accountants
	201	Assessors, controllers, and treasurers; local public admin.
	202	Bank officers and financial managers
	210	Credit men
	220	Office managers, n.e.c.
	222	Officials and administrators; public administration, n.e.c.
	312	Clerical supervisors, n.e.c.
	313	Collectors, bill and account
	320	Enumerators and interviewers
	321	Estimators and investigators, n.e.c.
	363	Real estate appraisers
44	224	Postmasters and mail superintendents
45	455	Locomotive engineers
46	456	Locomotive firemen
	712	Railroad brakemen
	713	Railroad switchmen
47	226	Railroad conductors
48	760	Longshoremen and stevedores
49	420	Carpet installers
	560	Tile setters
50	615	Dry wall installers and lathers
51	801	Farmers (owners and tenants)
	802	Farm managers
	822	Farm laborers, wage workers
	823	Farm laborers, unpaid family workers
	824	Farm service laborers, self-employed
	821	Farm foremen
52	480	Mechanics and repairmen; farm implement
	481	Heavy equipment mechanics, incl. diesel
	486	Mechanics and repairmen; railroad and car shop
	495	Not specified mechanics and repairmen
	502	Millwrights
53	404	Boilermakers
54	601	Asbestos and insulation workers
55	403	Blacksmiths
	412	Bulldozer operators
	424	Cranemen, derrickmen, and hoistmen
	436	Excavating, grading, and road machine operators; exc. bulldozer
	442	Forgemen and hammermen
	443	Furniture and wood finishers
	503	Molders, metal
	504	Molder apprentices
	533	Rollers and finishers, metal
	534	Roofers and slaters

Cluster number	Census code	Occupational title
55	614	Drillers, earth
	621	Filers, polishers, sanders, and buffers
	622	Furnacemen, smeltermen, and pourers
	623	Garage workers and gas station attendants
	626	Heaters, metal
	633	Meat cutters and butchers, manufacturing
	640	Mine operatives, n.e.c.
	641	Mixing operatives
	642	Oilers and greasers, exc. auto
	644	Painters, manufactured articles
	656	Punch and stamping press operatives
	661	Sailors and deckhands
	662	Sawyers
	706	Fork lift and tow motor operatives
	711	Parking attendants
	740	Animal caretakers, exc. farm
	752	Fishermen and oystermen
	750	Carpenters' helpers
	751	Construction laborers, exc, carpenters' helpers
	753	Freight and material handlers
	755	Gardeners and groundskeepers, exc. farm
	761	Lumbermen, raftsmen, and woodchoppers
	763	Teamsters
	764	Vehicle washers and equipment cleaners
	780	Miscellaneous laborers
	903	Janitors and sextons
56	334	Meter readers, utilities
	701	Boatmen and canalmen
	704	Conductors and motormen, urban rail transit
	710	Motormen; mine, factory, logging camp, etc.
57	392	Weighers
	754	Garbage collectors
58	703	Bus drivers
	705	Deliverymen and routemen
	714	Taxicab drivers and chauffeurs
	715	Truck drivers
	962	Guards and watchmen
59	230	Restaurant, cafeteria, and bar managers
	402	Bakers
	611	Clothing ironers and pressers
	630	Laundry and dry cleaning operatives, n.e.c.
	910	Bartenders
	911	Busboys
	912	Cooks, except private household
	913	Dishwashers
	914	Food counter and fountain workers
	915	Waiters
	916	Food service workers, n.e.c., exc. p.h.
60	635	Metal platers
	660	Riveters and fasteners

Cluster number	Census code	Occupational title
60	902	Cleaners and charwomen
	943	Elevator operators
61	620	Dyers
	625	Produce graders and packers, except factory and farm
	670	Carding, lapping, and combing operatives
	673	Weavers
	671	Knitters, loopers, and toppers
	672	Spinners, twisters, and winders
	674	Textile operatives, n.e.c.
62	551	Tailors
	563	Upholsterers
	663	Sewers and stitchers
	666	Stationary firemen
53	405	Bookbinders
64	602	Assemblers
	603	Blasters and powdermen
	604	Bottling and canning operatives
	605	Chainmen, rodmen, and axmen; surveying
	610	Checkers, examiners, and inspectors; manufacturing
	612	Cutting operatives, n.e.c.
	624	Graders and sorters, manufacturing
	636	Milliners
	643	Packers and wrappers, except meat and produce
	664	Shoemaking machine operatives
	665	Solderers
	681	Winding operatives, n.e.c.
	690	Machine operatives, miscellaneous specified
	692	Machine operatives, not specified
	694	Miscellaneous operatives
	695	Not specified operatives
	785	Not specified laborers
65	453	Jewelers and watchmakers
66	425	Decorators and window dressers
	631	Meat cutters and butchers, exc. manufacturing
67	506	Opticians, and lens grinders and polishers
68	445	Glaziers
69	514	Pattern and model makers, exc. paper
	561	Tool and die makers
	562	Tool and die maker apprentices
70	446	Heat treaters, annealers, and temperers
	454	Job and die setters, metal
	461	Machinists
	462	Machinist apprentices
	650	Drill press operatives
	651	Grinding machine operatives
	652	Lathe and milling machine operatives
	653	Precision machine operatives, n.e.c.
71	422	Compositors and typesetters
	423	Printing trades apprentices, exc. pressmen
	434	Electrotypers and stereotypers

Cluster number	Census code	Occupational title
71	435	Engravers, exc. photoengravers
	515	Photoengravers and lithographers
	530	Pressmen and plate printers, printing
	531	Pressmen apprentices
72	430	Electricians
	431	Electrician apprentices
	433	Electric power linemen and cablemen
	552	Telephone installers and repairmen
	554	Telephone linemen and splicers
73	961	Firemen, fire protection
74	331	Mail carriers, post office
	361	Postal clerks
	384	Telegraph operators
75	161	Surveyors
	323	Expediters and production controllers
	374	Shipping and receiving clerks
	381	Stock clerks and storekeepers
	413	Cabinetmakers
	415	Carpenters
	416	Carpenter apprentices
	440	Floor layers, exc. tile setters
	441	Foremen, n.e.c.
	444	Furriers
	450	Inspectors, scalers, and graders; log and lumber
	452	Inspectors, n.e.c.
	470	Mechanics and repairmen; air conditioning, heating, refrig.
	471	Mechanics and repairmen; aircraft
	482	Household appliance and accessory installers and mechanics
	483	Loom fixers
	485	Mechanics and repairmen; radio and television
	491	Mechanic, exc. auto, apprentices
	492	Miscellaneous mechanics and repairmen
	501	Millers; grain, flour, and feed
	505	Motion picture projectionists
	516	Piano and organ tuners and repairmen
	525	Power station operators
	535	Sheetmetal workers and tinsmiths
	536	Sheetmetal apprentices
	540	Shipfitters
	542	Shoe repairmen
	543	Sign painters and letterers
	545	Stationary engineers
	546	Stone cutters and stone carvers
	550	Structural metal craftsmen
	571	Specified craft apprentices, n.e.c.
	572	Not specified apprentices
	575	Craftsmen and kindred workers, n.e.c.
	680	Welders and flame-cutters
	762	Stock handlers
	770	Warehousemen, n.e.c.

Cluster number	Census code	Occupational title
76	401	Automobile accessories installers
	410	Brickmasons and stonemasons
	411	Brickmasons and stonemasons, apprentices
	421	Cement and concrete finishers
	472	Automobile body repairmen
	473	Automobile mechanics
	474	Automobile mechanic apprentices
	510	Painters, construction and maintenance
	511	Painter apprentices
	512	Paperhangers
	520	Plasterers
	521	Plasterer apprentices
	522	Plumbers and pipe fitters
	523	Plumber and pipe fitter apprentices
77	935	Barbers
78	613	Dressmakers and seamstresses, except factory
79	944	Hairdressers and cosmetologists
80	960	Crossing guards and bridge tenders
81	901	Chambermaids and maids, except private household
	922	Health aides, exc. nursing
	925	Nursing aides, orderlies, and attendants
	940	Boarding and lodging house keepers
	942	Child care workers, exc. p.h.
	950	Housekeepers, exc. p.h.
	980	Child care workers, p.h.
82	634	Meat wrappers, retail trade
83	83	Radiologic technologists and technicians
84	981	Cooks, p.h.
	982	Housekeepers, p.h.
	983	Laundresses, p.h.
	984	Maids and servants, p.h.

Table A-2

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Four Functions Involving Job Characteristics (DOT)

Group	Function 1	2	3	4
9	3.93	0.04	0.38	-0.04
10	1.86	0.08	-0.02	0.14
14	1.90	-0.77	0.23	0.26
35	1.32	0.93	-0.68	-0.26
36	2.32	0.36	-0.63	-0.40
41	-1.09	-0.97	-1.12	-0.04
42	-1.22	-0.76	-0.12	0.60
43	2.24	-0.42	0.55	0.42
55	-2.62	0.32	0.79	0.14
59	-1.78	-1.20	0.85	-1.21
64	-2.55	-1.00	-0.44	0.08
75	-1.10	0.92	-0.38	-0.04
76	-1.71	2.64	-0.04	-0.01

Note. Job characteristics measured by four factor-based scales for Department of Labor data (fourth edition of the DOT).

Table A-3

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Four Functions Involving Personal Characteristics

Group	Function 1	2	3	4
9	-4.70	-0.88	0.52	-0.01
10	-2.52	1.62	1.23	0.40
14	-0.43	-0.94	-0.84	0.65
35	-1.80	-0.30	-0.50	-0.92
36	-2.15	-0.99	-0.28	-0.61
41	-0.46	2.71	-0.53	-0.13
42	0.50	1.55	-0.60	-0.86
43	-0.82	-0.13	-0.56	1.18
55	3.21	-0.79	0.71	-0.33
59	1.61	1.70	0.73	0.54
64	1.92	1.16	0.15	0.42
75	1.63	-1.20	-0.63	0.18
76	2.86	-1.32	0.36	0.03

Table A-4

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Seven Functions Involving Job and Worker Characteristics

	Function						
Group	1	2	3	4	5	6	7
9	-4.93	0.64	0.26	0.48	0.66	0.02	-0.23
10	-2.86	-1.27	0.63	1.42	-1.04	0.43	0.13
14	-0.98	0.74	-2.03	-0.62	-0.05	0.08	0.09
35	-1.92	0.44	1.23	-0.73	-0.17	-0.12	0.40
36	-2.59	1.00	0.42	-0.70	-0.36	-0.85	0.35
41	0.00	-2.93	0.63	-0.60	-0.08	0.25	-0.25
42	0.75	-1.68	-0.01	-0.55	0.33	0.18	0.95
43	-1.47	0.20	-2.04	0.10	-0.63	0.75	-0.01
55	3.45	0.92	0.05	0.65	0.50	0.05	0.28
59	1.79	-1.68	-0.88	1.00	-0.51	-1.43	-0.18
64	2.50	-1.47	-0.04	0.01	0.49	0.17	-0.65
75	1.75	1.28	0.26	-0.73	-0.16	-0.06	-0.47
76	2.70	2.20	1.35	0.45	-1.23	0.60	0.02

Note. Job characteristics measured by four factor-based scales for Department of Labor Data.

Table A-5

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Six Functions Involving PAQ Overall Dimension Scores

Group	Function 1	2	3	4	5	6
9	2.93	-0.34	-1.79	1.94	-0.46	-0.53
10	2.78	-0.96	-2.32	0.89	0.11	0.52
14	1.56	0.61	1.47	0.16	1.28	0.54
35	1.64	1.03	0.24	0.89	-0.35	-0.31
36	1.68	1.62	0.90	-0.20	-0.41	-1.18
41	1.48	-1.05	-0.17	-2.12	-0.95	0.22
42	0.62	-1.00	-0.21	0.22	0.23	0.49
43	2.25	0.71	0.50	-0.34	0.79	0.15
55	-2.71	-0.06	-0.69	-0.36	0.65	0.03
59	-1.22	-4.57	1.74	1.22	-0.50	-0.22
64	-2.22	-0.27	-0.49	-0.31	0.43	-0.77
75	-1.57	1.97	0.03	0.49	-0.71	0.17
76	-2.83	1.87	0.85	0.94	-1.72	1.28

Note. Based on PAQ data, N = 148 occupations.

Table A-6

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Seven Functions Involving Job and Worker Characteristics

	Function						
Group	1	2	3	4	5	6	7
9	5.96	0.43	-1.56	-2.90	0.42	0.09	0.27
10	4.69	-1.24	-0.14	-2.40	-0.82	-0.85	-0.35
14	1.07	1.80	-0.59	1.79	-1.36	-0.36	0.26
35	2.26	1.94	-0.41	-0.01	0.77	0.21	-0.74
36	2.37	2.43	-0.12	0.33	0.34	1.53	-0.14
41	2.25	-2.43	2.20	0.96	0.85	0.06	-0.05
42	0.74	-1.28	0.31	0.67	-0.18	-0.81	-0.88
43	2.13	1.16	0.29	0.91	-1.25	-0.11	0.24
55	-4.19	-0.24	0.19	-0.73	-0.76	0.45	-0.67
59	-0.79	-3.81	-3.60	1.32	0.64	0.19	0.18
64	-2.14	-1.38	0.69	-0.88	-0.37	0.43	1.36
75	-2.26	1.94	0.09	-0.25	0.86	-0.75	0.62
76	-4.70	1.62	-0.28	-0.10	2.24	-1.18	-0.50

Note. Based on PAQ data, N = 148 occupations.

Table A-7

Means and Standard Deviations of Occupational Characteristics for Clusters

		GED		Data		People		Things		SVP		Selfdir	
Cluster	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
5	5	3.98	.59	2.80	.29	6.76	.80	6.33	2.72	5.78	.52	1.46	.32
9	30	5.70	.42	1.86	.26	2.12	.47	7.87	.43	7.73	.44	2.35	.11
10	10	4.73	.55	1.75	1.05	3.79	2.02	7.77	.56	6.39	1.41	1.95	.39
12	5	5.00	.09	1.02	.05	.70	1.19	7.59	.93	7.13	.30	2.21	.23
14	15	4.21	.58	1.97	.76	4.97	.96	7.89	.18	6.15	1.02	1.73	.25
30	6	5.25	.25	.75	.41	5.55	1.62	7.85	.21	7.02	.78	2.04	.10
34	6	5.32	.82	.84	1.14	7.68	.62	4.36	3.15	6.98	.94	1.57	.38
35	11	4.55	.58	1.77	.90	5.74	2.31	5.11	2.96	6.35	.76	1.52	.51
36	15	4.93	.53	1.32	.72	7.38	.97	5.98	2.47	6.82	.67	1.59	.40
37	6	5.25	.42	.67	.62	7.72	.24	1.63	.36	7.57	.39	1.38	.15
38	5	5.40	.31	.48	.57	7.26	1.23	2.68	1.56	7.67	.38	1.57	.12
40	7	3.57	.52	3.67	1.49	6.85	.84	7.94	.06	5.08	1.24	1.29	.30
41	19	3.25	.37	4.11	1.13	7.51	.70	6.85	1.83	3.94	.72	.97	.33
42	17	2.98	.60	4.64	1.75	6.08	1.10	7.29	1.63	3.32	1.09	.99	.35
43	11	4.50	.64	1.70	.62	6.05	1.29	7.86	.30	6.47	1.52	1.70	.34
51	6	3.33	.69	4.11	2.84	7.04	1.42	4.17	1.82	5.26	1.65	.75	.54
52	5	3.86	.12	2.47	.38	7.92	.09	1.32	.38	6.75	.22	.87	.06
55	36	2.62	.52	6.20	1.15	7.87	.34	4.04	1.77	4.20	1.28	.25	.24
58	5	2.83	.20	5.35	1.24	6.58	.79	4.62	2.18	3.74	.79	.60	.26
59	11	2.57	.84	5.96	1.84	7.36	.62	5.94	2.54	3.71	1.71	.52	.51
61	7	2.40	.33	6.67	.29	7.97	.04	4.56	1.38	3.45	.82	.10	.09
64	17	2.52	.49	5.84	1.60	7.96	.05	4.51	1.63	3.70	1.26	.18	.23
70	8	3.30	.54	4.82	1.72	7.96	.07	1.90	1.37	5.16	1.25	.50	.29
71	7	3.50	.29	5.22	1.25	7.95	.09	2.48	.74	6.42	.65	.60	.17
72	5	3.85	.16	2.56	.45	7.77	.18	1.21	.18	6.72	.44	.87	.08
75	37	3.53	.55	3.75	1.74	7.73	.68	3.10	2.33	5.90	1.35	.74	.35
76	14	3.32	.41	4.57	2.04	7.78	.61	1.60	1.03	6.97	.53	.71	.24
81	7	3.19	.55	5.07	2.32	6.22	1.49	7.59	.45	3.86	1.70	.98	.52

Table A-8

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Job Analysis Variables

Discriminatory variable	Fn. 1		Fn. 2		Fn. 3		Fn. 4		Fn. 5	
	r	d	r	d	r	d	r	d	r	d
General Educ. Devt.	-.87	-1.00	-.36	-.19	.28	-.24	-.15	-1.41	-.17	-.05
Data	.70	.06	.61	.84	-.18	.45	-.20	-.69	.36	.72
People	.83	.55	-.38	-.83	.13	.10	-.30	-.32	.00	.44
Things	-.54	-.14	.14	-.33	-.66	-.17	.26	.32	.61	1.10
Specific Voc. Prep.	-.58	.53	-.35	.11	.70	1.30	.09	.90	-.22	.97
Percent of variance		71.18		15.18		9.75		2.24		1.65
Canonical R		.94		.78		.71		.44		.38
Λ before removing this function		.02*		.13*		.34*		.69*		.85*

Note. N for discriminant analysis is 210. N for correlations of discriminatory variables with discriminant scores is 427. Based on third edition DOT ratings.

* $p<.001$

Table A-9

Standardized Multiple Discriminant Function Coefficients and Correlations of Discriminatory Variables with Functions in a Discriminant Analysis of Mobility-Based Occupational Groups: Occupational and Worker Characteristics

Discriminatory variable	Fn 1		Fn 2		Fn 3		Fn 4		Fn 5		Fn 6		Fn 7	
	r	d	r	d	r	d	r	d	r	d	r	d	r	d
General educational devt.	-.86	-.56	.28	-.14	-.40	-.12	-.01	.10	.01	.15	-.05	-.48	.05	-.91
Data	.69	.00	-.20	.09	.63	.86	-.10	-.48	.07	-.06	.16	.46	-.28	-.41
People	.83	.48	-.08	-.19	-.33	-.73	-.42	-.52	.16	-.14	.04	.16	-.03	-.44
Things	-.49	.02	-.45	-.18	.21	-.27	.43	.24	-.35	-.68	.00	.01	-.45	-.59
Specific vocational prep.	-.59	.30	.53	.47	-.42	.17	-.16	-.91	-.10	-1.02	.01	.17	.36	.50
Median employed male age	.06	.17	.28	.04	.00	-.10	.36	.32	-.18	.30	.43	.63	.02	.10
Median employed female age	.16	.01	.16	.06	.24	.21	.26	.00	-.63	-.68	.22	.11	-.06	-.25
Years of education[a]	-.94	-.53	.16	.03	-.28	.07	-.12	-.53	.21	.35	.21	.56	.00	-.02
Percentage male[b]	.13	.17	.93	.81	-.26	-.14	.18	.40	.36	.23	.01	-.18	-.07	-.32
Percentage of men black[c]	.41	.07	-.24	.10	.53	.17	-.21	-.29	-.16	.04	-.42	-.52	-.40	-.20
Percentage of women black[c]	.34	-.16	-.10	.11	.45	.14	-.16	-.27	-.29	-.21	-.29	-.02	-.38	-.11
Percent of variance	62.40		14.33		11.52		4.70		3.13		1.55		1.35	
Canonical R	.95		.83		.80		.65		.57		.44		.41	
Λ before removing this function	.00*		.02*		.08*		.23*		.39*		.58*		.71*	

Note. N for discriminant analysis is 210. N's for correlations of discriminatory variables with discriminant scores range from 375 to 427. Occupational analysis data are based on third edition DOT ratings.

* $p < .001$

[a] A weighted composite of men's and women's schooling for persons in the experienced labor force.

[b] Experienced civilian labor force.

[c] Employed workers.

Table A-10

Efficiency of Various Sets of Discriminatory Variables in Classifying Occupations to Known Mobility-Based Groups (N=210 Occupations)

Set of discriminatory variables	No. of functions	Pct. correctly classified[a]	K	SE_K
Occupational analysis data (3rd ed. DOT)	5	57.0	.521	.035
Worker characteristics				
Education	1	38.9	.308	.032
Race, sex, and age[b]	4	44.3	.371	.034
All	4	60.7	.558	.034
Occupational analysis data plus				
Education only	5	59.4	.549	.034
All personal characteristics	7	70.5	.672	.032
Personal characteristics and rewards[c]	9	74.2	.714	.031

[a] Prior probalities set proportional to group size.

[b] Percentage male, median male age, median female age, percentage males black, percentage females black.

[c] Rewards include prestige, median male income, and median female income.

Table A-11

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Five Functions Involving Job Characteristics

(Third Edition DOT)

Group	Function 1	2	3	4	5
9	-5.23	1.49	0.58	-0.35	0.10
10	-3.10	0.19	-0.44	0.58	-0.34
14	-1.64	-0.54	-0.34	1.09	0.24
35	-1.39	-1.05	0.12	-0.11	-0.96
36	-1.06	-2.38	0.37	-0.90	0.18
41	0.89	-0.87	-1.26	-0.28	0.21
42	0.09	0.52	-1.96	0.18	-0.54
43	-1.31	-1.77	-0.03	0.55	0.84
55	2.79	1.10	0.18	-0.24	0.19
59	2.15	0.88	-0.54	0.17	0.50
64	2.80	0.92	-0.63	-0.29	-0.01
75	1.61	-0.70	0.93	0.14	-0.49
76	2.97	0.47	2.96	0.58	0.07

Note. Based on third edition DOT data: GED, Data, People, Things, and SVP.

Table A-12

Group Centroids for Mobility-Based Groups in the Reduced Space Defined by Seven Functions
Involving Third Edition DOT Ratings and Worker Characteristics

	Function						
Group	1	2	3	4	5	6	7
9	-5.97	1.00	1.42	-0.19	0.26	0.36	-0.06
10	-3.52	-1.10	0.80	-0.47	-1.18	-1.30	0.24
14	-1.08	0.57	-0.91	1.95	-0.65	0.19	0.10
35	-1.80	0.15	-1.30	-0.32	1.12	-0.36	0.64
36	-1.50	0.38	-2.92	-1.13	0.48	-0.26	-0.79
41	0.42	-3.06	-0.51	-0.71	0.07	0.39	0.13
42	0.21	-1.83	0.32	1.32	0.96	-0.63	0.26
43	-0.90	-0.28	-1.67	0.70	-1.53	0.34	-0.42
55	3.37	1.03	1.06	0.17	0.27	-0.26	-0.55
59	2.01	-1.38	1.38	-0.59	-0.92	-0.10	-0.17
64	2.73	-1.18	1.12	-0.20	0.21	0.84	0.00
75	1.98	1.25	-0.99	0.10	0.13	0.20	0.48
76	3.27	2.47	0.45	-1.57	-0.86	-0.22	0.98